PLACERITA-SOLEDAD-VASQUEZ ROCKS AREA

SOLEDAD BASIN

LOS ANGELES COUNTY,

CALIFORNIA

Prepared for the 1965 FIELD TRIP of

AMERICAN ASSOCIATION OF PETROLEUM GEOLOGIST

PACIFIC COAST SECTION

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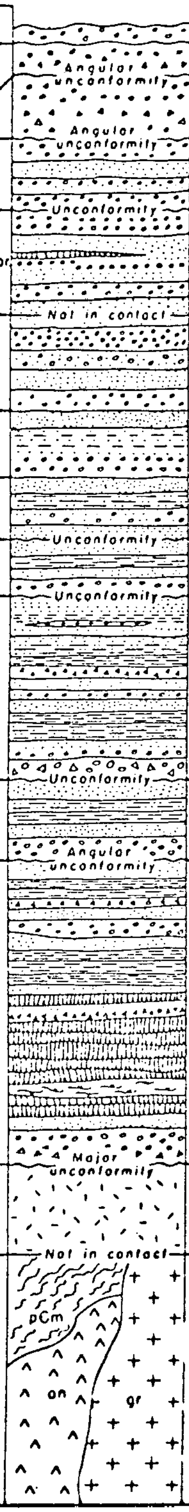
GENERALIZED GEOLOGIC COLUMN NORTH OF SAN GABRIEL FAULT



Era	Age	Formation or member	Lithology	Maximum thickness (feet)	Description
Quaternary	Recent	Alluvium		100 +	Coarse sand, gravel, and boulders of Santa Clara River and its tributaries.
Quaternary	Upper Pleistocene	Terrace deposits	Angular unconformity	200	Fanglomerate, stream terrace gravels, older alluvium.
Quaternary	Middle Pleistocene	Pacoima fm.	Angular unconformity	200	Brown and reddish-brown, poorly sorted conglomerate and fanglomerate; folded.
Quaternary	Lower Pleistocene	Saugus fm.	Unconformity	650	Light-colored, poorly sorted, loosely consolidated non-marine conglomerate and coarse sandstone; fluviatile and alluvial-fan deposits.
Tertiary	Upper Pliocene	Pico formation: Sunshine Ranch mbr.	Not in contact	1,300	Non-marine fluviatile, lacustrine, and brackish-water gray gravel, brown and greenish sandstone, sandy mudstone, conglomerate and thin white freshwater limestone beds.
Tertiary	Upper Pliocene	Pico formation: Upper Pico mbr.		Few hundred	In San Gabriel fault zone: light brownish poorly sorted conglomerate and coarse greenish sandstone; brackish-water to continental (?). Not found north of the fault zone.
Tertiary	Middle Pliocene	Pico formation: Lower Pico mbr.		700 (?)	Marine brownish sandstone, siltstone and conglomerate in the San Gabriel fault zone. Not found north of the fault.
Tertiary	Lower Pliocene	Repetto fm.	Unconformity	500	Marine gray and brownish-gray siltstone, fine-grained sandstone, mudstone; pebble and boulder beds.
Tertiary	Upper Miocene	Modelo fm.	Unconformity	500	Marine buff and gray sandstone, silty shale, diatomaceous shale, and conglomerate.
Tertiary	Upper Miocene	Mint Canyon fm.	Unconformity	4,500	Fine- to coarse-grained more or less well-consolidated non-marine sediments of fluviatile and lacustrine origin: red and reddish-brown conglomerate and breccia, very coarse basal breccias; yellow, red, and greenish sandstone, siltstone and mudstone; coarse gray sandstone and conglomerate; thin-bedded lacustrine siltstone and volcanic tuff beds.
Tertiary	Middle to lower Miocene	Tick Canyon fm.	Angular unconformity	600	Fluviatile and lacustrine reddish sandstone, siltstone and claystone, and gray, tan, and reddish conglomerate, usually well-cemented and well-stratified.
Tertiary	Lower Miocene to upper Eocene	Vasquez fm.	Major unconformity	8,600	Non-marine light-colored and highly colored red, yellow, and buff sandstone, conglomerate, fanglomerate, and lesser proportions of mudstone and shale; flows of black and reddish vesicular basalt and andesite, purplish breccia, and minor beds of lithic tuff; borate-and gypsum-bearing shale and sandstone. Monolithologic breccias are characteristic of parts of the formation.
	Upper Jurassic (?) Lower Cretaceous	Syenite - Hornblende diorite	Not in contact		Dark red-weathering augite and quartz augite syenite and related hornblende diorite.
	Pre-Cambrian	Mendenhall gneiss and anorthosite-gabbro group	pCm, an, gr		Mendenhall blue-quartz-feldspar gneiss (pCm) intruded by anorthosite-gabbro rocks (an); all intruded by Upper Jurassic (?)-Lower Cretaceous (?) granitic rocks (gr).

Figure 3. Generalized geologic column north of San Gabriel fault.

SUMMARY OF THE GEOLOGY OF THE SAND CANYON - PLACERITA CANYON AREA

by

R. R. MORRISON
Richfield Oil Corporation

The sediments of the Sand Canyon - Placerita Canyon area lie in a broad syncline formed at the right angle intersection of basement faults bounding the Soledad Basin on the south.

The oldest rocks of the area are the metamorphic and plutonic rocks of the San Gabriel complex, which bound the area on the east and south, and presumably underlie the sedimentary basin. South of the San Gabriel fault the basement consists of metasediments but to the north consists of gneiss and anorthosite with associated gabbroic rocks.

The sediments of this part of the Soledad Basin consist of six Tertiary formations and Quaternary deposits, in unconformable contact with each other. The late Miocene Tick Canyon formation (Mtc?) is a steeply dipping, well-indurated gneiss and schist breccia, in a matrix of dark red siltstone. Its angularity, clast size ranging up to boulders and lack of sorting suggests deposition at the base of a steep slope with a limited amount of transport.

The Mint Canyon formation (Mmc) is locally represented by more than 4500' of continental shales, sands and ridge-forming conglomerates of continental origin. These rocks are light colored, and contain water-laid tuff beds and fresh water fossils. A thick shale member of this formation is the source for the large landslides in the central part of the map. This late Miocene formation is known only north of the San Gabriel fault.

The Castaic formation (Mc) is the time and lithologic equivalent of the Mohnian (U. Miocene) Modelo formation of the Ventura Basin and may once have been continuous with it. Fifteen miles north at its type locality the Castaic formation is sandy to conglomeratic and may be a shallow water facies of the silicious and diatomaceous shale present at Sand Canyon.

The Towsley formation (Pt) is the oldest formation present on both sides of the San Gabriel fault. Here it is a flat-lying brown siltstone and is the time equivalent of the Repetto formation of the Los Angeles Basin.

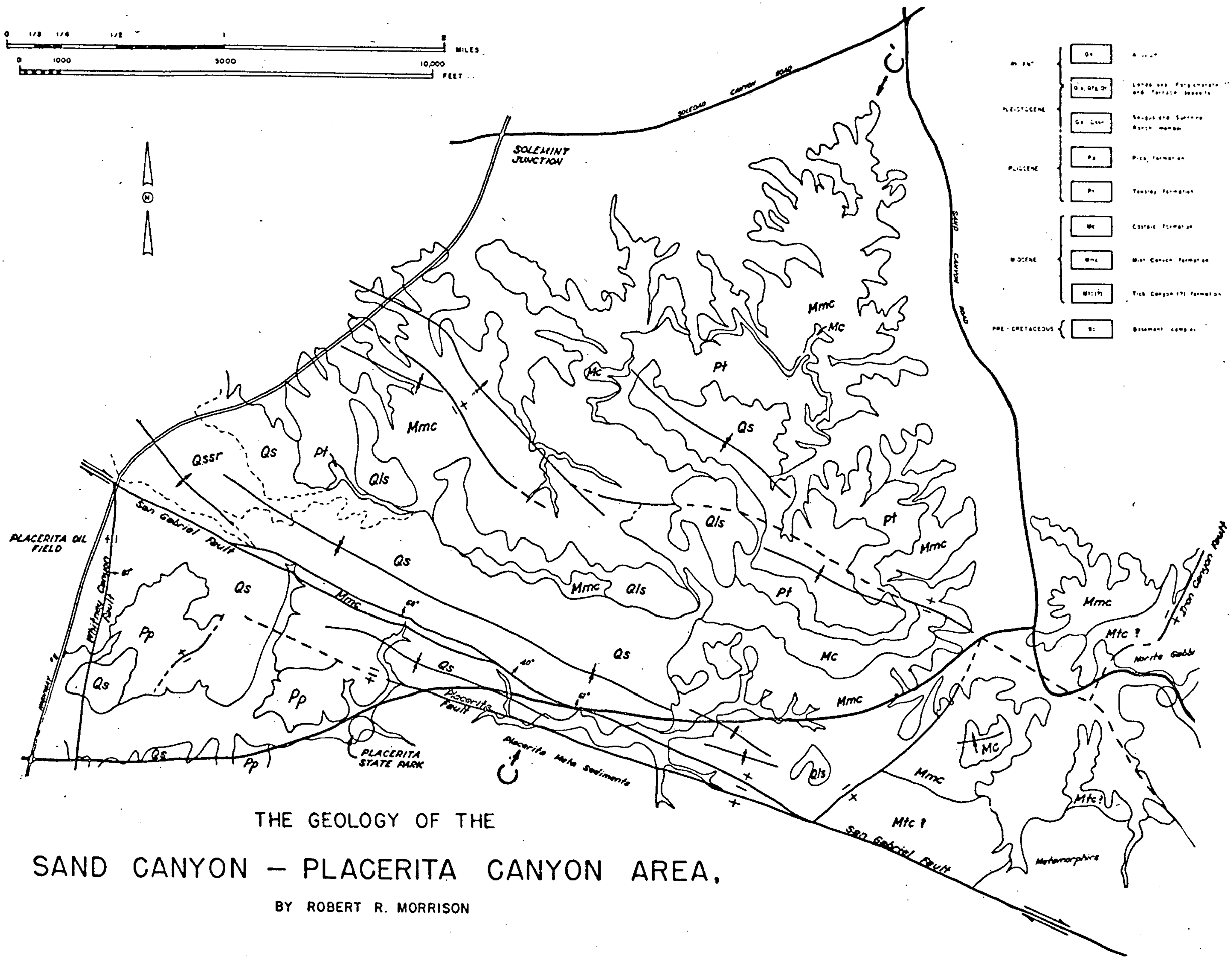
Overlying all of the older beds is the continental Saugus formation (Qs) with its brackish water equivalent, the Sunshine Ranch member (Qssr). The Saugus formation is a highly cross-bedded and lenticular, rust colored pebble and cobble conglomerate of upper Pliocene and Pleistocene age.

The San Gabriel right lateral slip fault traverses the area along its southern border and has profoundly affected local structure and regional stratigraphy. Deformation and movement along the fault have occurred more or less continuously throughout the Tertiary. Locally, the San Gabriel fault shows more than 6000' of vertical movement, down to the north. Dips of 40° to 68° north have been measured in the fault plane. Wells on the north end of the Placerita field penetrate the fault and verify its northerly dip. The major differences between basement and sedimentary rocks on opposite sides of the fault are considered significant evidence for large scale horizontal movement along the San Gabriel fault. The Placerita fault is a typical branch of the San Gabriel, taking up some of the major movement along the fault zone. This fault borders basement rocks and is separated from the main trace of the San Gabriel fault by a Saugus-filled graben.

The Whitney Canyon fault and Iron Canyon faults are large scale basement faults that intersect the San Gabriel fault on opposite sides. Latest movement on the Whitney Canyon fault is the reverse of the basement movement and forms the closure on the east side of the Placerita field.

The general synclinal nature of the area has persisted due to the constant uplift of the basement rocks. Younger formations tend to be preserved on synclinal hills.

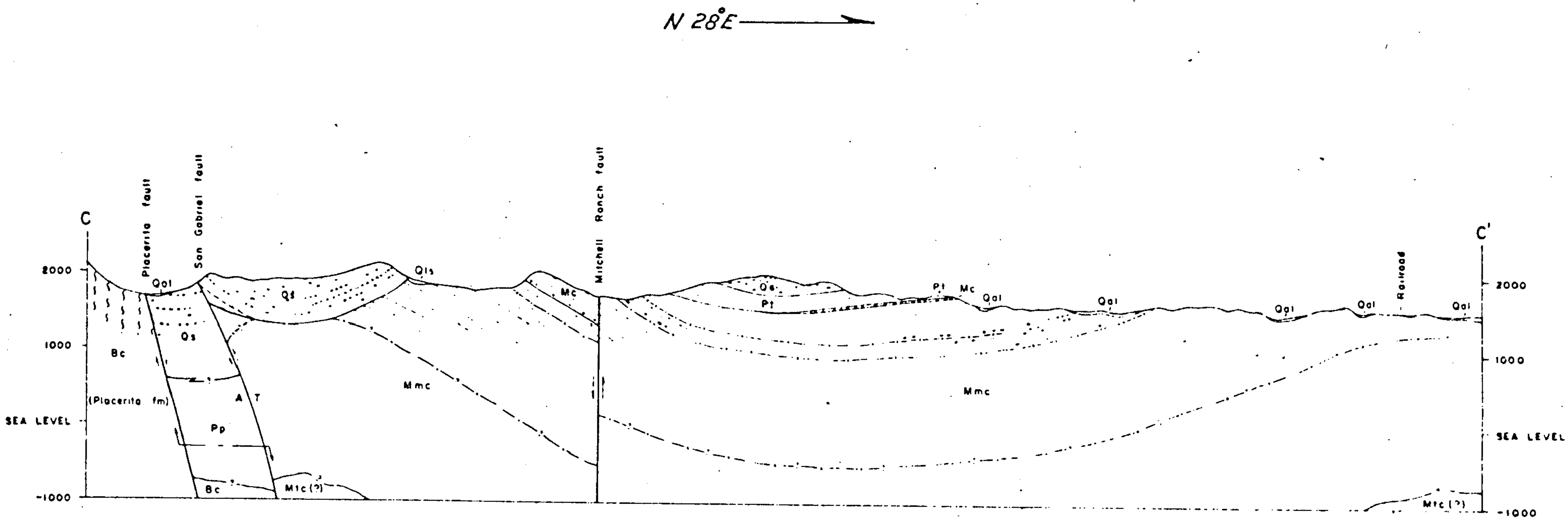
The area will continue to be important to the problem of lateral slip on the San Gabriel fault due to its location at the juncture of sediments and basement rocks along the major faults.



THE GEOLOGY OF THE

SAND CANYON – PLACERITA CANYON AREA,

BY ROBERT R. MORRISON



Geologic cross section C - C', Sand Canyon - Placerita Canyon area.

Robert R. Morrison

GEOLOGY OF THE PRE-CENOZOIC BASEMENT TERRANE BORDERING THE SOLEDAD BASIN

by P. L. Ehlig

Introduction

The sedimentary formations of the Soledad Basin are largely composed of material eroded from pre-Cenozoic basement terrane to the north and east of the basin. The basement terrane includes at least six major rock units: (1) Mendenhall gneiss, (2) anorthosite-gabbro complex, (3) Lowe granodiorite, (4) Placerita formation, (5) granitic rocks (quartz diorite, granodiorite, and quartz monzonite), and (6) Pelona schist. Each unit contains distinctive rock types that are easily recognized in clasts of pebble-size or larger. Except for the granitic rocks, each unit crops out within a limited geographic area as shown on the attached geologic map. Contacts between rock units are generally steep and have probably undergone insignificant erosional displacement of their outcrop traces since Miocene time. Thus, a knowledge of the basement terrane could be of great value to a study of sedimentary formations within the Soledad Basin.

Mendenhall Gneiss

Lavender-blue quartz tints the Mendenhall gneiss a distinctive blue-gray color. Similar quartz is found sparingly in some portions of the anorthosite-gabbro complex, but is not found in the other basement rocks.

The Mendenhall gneiss, the oldest dated rock in southern California, is more than 1.2 billion years old (Silver and others, 1963). It includes quartzo-feldspathic rocks and amphibolite which were metamorphosed under conditions of the granulite facies during Precambrian time. Subsequent remetamorphism under amphibolite facies conditions has destroyed many of the original mineral assemblages. The lavender-blue quartz and white to gray perthite are the most widely preserved relics of the granulite metamorphism. Originally abundant pyroxene and garnet have been largely replaced by biotite and hornblende. The rock is highly distinctive where equant crystals of hypersthene and garnet have been replaced by fine-grained platy aggregates of red-brown biotite.

Clasts from the Mendenhall gneiss are abundant in Pliocene and younger rocks to the south of the San Gabriel fault, but are only sparingly present in formations to the north of the fault. Clasts within the Pico formation to the north and west of Placerita Canyon State Park are largely derived from the Mendenhall gneiss. This supports the hypothesis of right lateral displacement along the San Gabriel fault.

Anorthosite-Gabbro Complex

This complex crops out over an area of about 80 square miles in the western San Gabriel Mountains. It projects beneath the sedimentary formations along the eastern edge of the Soledad Basin.

The complex was emplaced about 1.2 billion years ago (Silver and others, 1963). Subsequent metamorphism under amphibolite facies conditions has produced extensive alteration. Original pyroxene is nearly everywhere replaced by hornblende, and many rocks have a metamorphic fabric.

Purplish gray to white andesine anorthosite is the most abundant rock type. Gabbro and diorite are next in abundance. Syenite is common in the northern portion of the complex. Ilmenite-magnetite rock occurs in small widely scattered bodies. Many of the rocks are exceptionally coarse-grained.

Clasts derived from the anorthosite-gabbro complex occur within all sedimentary formations of the Soledad Basin.

Lowe Granodiorite

Granodiorite exposed on Mount Lowe, to the west of Mount Wilson, is part of a compositionally zoned pluton that crops out over an area of roughly 100 square miles within the central and northern San Gabriel Mountains. The rock varies from hornblende diorite to alkali granite. The most common rock types contain large crystals of potash feldspar and hornblende scattered through a finer grained matrix of plagioclase. Most rocks contain little quartz.

The age of the Lowe granodiorite is unknown. It may be Precambrian. It has been affected by the same metamorphic and intrusive events that affected the anorthosite-gabbro complex. A belt of cataclastic rocks separate it from the Mendenhall gneiss and the anorthosite-gabbro complex within the area studied.

Clasts of Lowe granodiorite are common in all sedimentary formations of the Soledad Basin.

Placerita Formation

Placerita Canyon State Park includes the type area of the Placerita formation. Good exposures of quartz, marble, biotite-sillimanite schist, and quartzo-feldspathic gneiss are present along the canyon bottom to the east of the campground.

The formation is intricately intruded by granodiorite and quartz diorite and, in general, cannot be mapped as a separate unit. In many places it is impossible to tell whether the rocks are of igneous or metasedimentary origin.

The Placerita formation is restricted to the south side of the San Gagriel fault. It has had a much simpler metamorphic history than the rocks described above. It may represent a Paleozoic or Mesozoic cover that was deposited on the older igneous-metamorphic terrane that is presently exposed to the north of the San Gabriel fault.

Clasts characteristic of the Placerita formation are absent from sedimentary formations of the Soledad Basin.

Granitic Rocks

Intrusions of quartz diorite, granodiorite, and quartz monzonite are wide spread throughout most of the basement terrane of southern California. This group includes several easily recognized rock types; however, their wide distribution make them of minor value in establishing source areas.

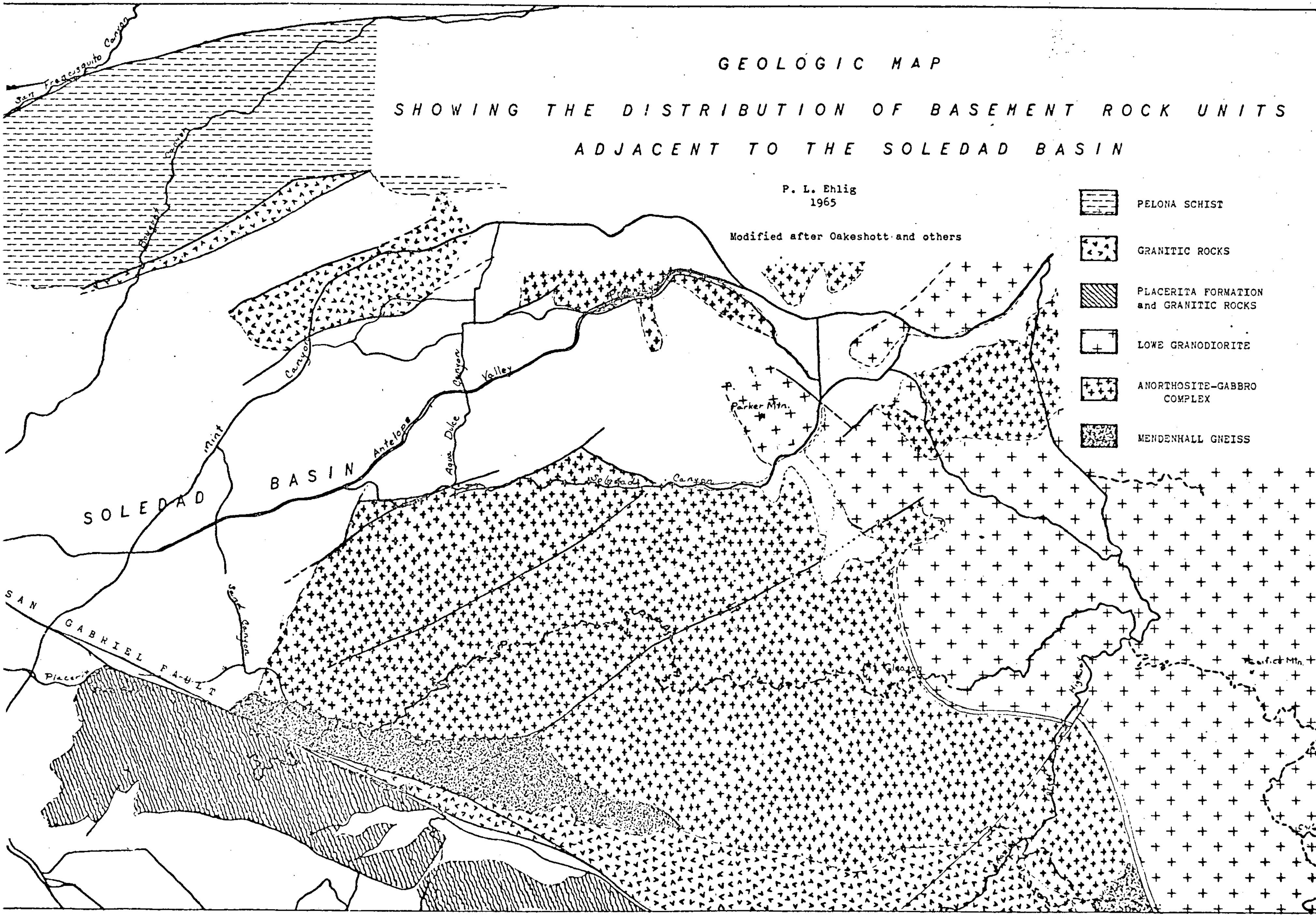
Pelona Schist

Gray-colored muscovite-quartz-albite schist and green actinolite-chlorite-albite-epidote schist are the dominant rock types. Both are currently popular building stones. Minor rock types include marble, quartzite, talc-actinolite schist, and serpentenite.

The schist has formed through low grade regional metamorphism of a thick sequence of interbedded graywacke, argillite and basic volcanics. The quartzite is derived from chert.

Although Pelona and Pelona-like schists are widely distributed along the San Andreas and Garlock faults, the schist is locally restricted to Sierra Pelona and Ritter Ridge to the north of the Soledad Basin. Faults separate both occurrences from all other basement rocks.

Clasts of Pelona schist are common within the Mint Canyon formation and younger formations to the scuth and southwest of Sierra Pelona. Clasts are also found in Pliocene and Pleistocene conglomerates along the north side of the San Fernando Valley.


GEOLOGIC MAP
SHOWING THE DISTRIBUTION OF BASEMENT ROCK UNITS
ADJACENT TO THE SOLEDAD BASIN
P. L. Ehlig
1965
Modified after Oakeshott and others
PELONA SCHIST
GRANITIC ROCKS
PLACERITA FORMATION and GRANITIC ROCKS
LOWE GRANODIORITE
ANORTHOSITE-GABBRO COMPLEX
MENDENHALL GNEISS
San Francisquito Canyon
Mint
Canyon
SOLEDAD BASIN
Antelope Valley
Agua Dulce Canyon
Soledad Canyon
Parker Mtn.
SAN GABRIEL FAULT
Sand Canyon

PLACERITA OIL FIELD
Los Angeles County, California

by
F. J. Karmelich, Petroleum Engineer
Sunset International Petrolium Corporation

Introduction: The Placerita oil field is located in the eastern portion of the Ventura Basin, about two miles northeast of Newhall. The field extends over Section31, T4N, R15W, and into the adjoining sections on the north, west, and south. It is crossed by the north-south trending U. S. Highway No. 14 and the east-west Placerita Canyon Road. The field is divided into two distinctive productive areas known as the Kraft-York area of heavy oil and the Juanita area of high gravity oil.

History and Development: The field was discovered in 1920 in the Kraft-York Area by the Equity Oil Company "Daisy" No. 1 (now shown on Contour Map as Crestmont Oil Co. "York" No. 1) for a few barrels of 14° gravity at a depth of 975'. Four wells were drilled between 1920 and 1933 and produced from 6 to 19 BOPD. In April 1948, the area was rediscovered in the Nelson-Phillips Oil Co. "Kraft" No. 1, completed flowing 70 BOPD of 15.6° gravity from 580' to 717'. (This well is now known as Sunset International Petroleum Corporation "Kraft" No. 1.)

In January 1949, the Juanita area was discovered by the Ramon Somavia "Juanita" No. 1, flowing 340 B/D of 22.4 gravity oil from the Lower Kraft zone at a total depth of 1830'. This well is about one mile north of the Nelson-Phillips "Kraft" and caused the most sensational town-lot boom the oil industry has known since the early 1920's. Approximately 140 wells were drilled on roughly 60 acres located in the N/2 of the NE/4 of Section 31 and the production from the Juanita area reached a peak of 860,000 barrels per month in September 1949. By July 1951, the production had declined rapidly to approximately 200,000 barrels per month and since that time has gradually declined. As of January 1, 1962, the Juanita area had produced 20,494,286 barrels of oil from approximately 125 acres on which had been drilled 212 producible wells. Its production for 1961 was 371,081 barrels of oil from 112 producible wells. As of January 1, 1962, the cumulative production for the low gravity Kraft-York area was 12, 569,256 barrels from approximately 615 acres and its production for 1961 was 474,473 barrels from 189 producing wells. Since 1961, the field production has not been segregated by the Conservation Committee of California Oil Producers. As of January 1, 1965, the entire field had a cumulative production of 34, 905,476 barrels of oil from a proven area of approximately 740 acres.

In 1956 and 1957, the shallowest producing zone in the Kraft-York area was developed in the SE/4 of the SW/4 of Section 31. Ten wells were drilled to an average depth of 720' and completed in approximately 100' of conglomeratic sand for initial rates of 10 to 15 barrels per day of 12.8 gravity oil. This zone was first discovered in April 1951 when Standard Oil Company completed "Placerita" 13 in the NW/4 of Section 6, producing at an average rate of 55 barrels of oil and 2 barresl of water from the new zone and the Upper Kraft. Only 10 more such dual wells were completed by 1956. This new zone, located approximately 200' above the Upper Kraft is known as the Upper Upper Kraft within the Upper Kraft Shale Series of Willis(3). The cumulative production for the 10 wells completed in the Upper Upper Kraft zone is

149, 990 barrels as of January 1, 1965, and its current daily rate per well is 3 barrels of oil and 1 barrel of water, naturally. By the advent of steam injection current rates have increased to as high as 60 BOPDPW for the 3 wells located on Sunset International Petr. Corp.'s Kraft lease. Currently, Sunset is expanding its cyclic steam injection program for the Upper Upper Kraft zone. It has drilled 4 new wells and is preparing to drill 4 additional wells.

In 1958, Sunset International Petroleum Corporation started a pilot water flood on its K.P.M. lease in NW/4 SE/4 of Section 31, and subsequent expansion of the flood has led to a total of 28 water injection wells and its areal extent new includes its G.P.M. and Kraft leases.

The low gravity crude oil is currently being stimulated by cyclic steam injection by practically all of the operators within the field,and some are expanding their steam operations. The steam generators vary in size from 8½ to 20 million B.T.U. per hour.

In the S/2 of Section 6, T.3N, R.15W, Occidental Petroleum Corporation is operatiing a pilot fire flood, but results are being withheld.

Stratigraphy: All the productive sands are of Pliocene age and consist of sandstone and conglomerates. Formations penetrated within the field limits from top to bottom are: Saugus of Lower Pleistocene, Pico formation of upper and middle Pliocene, Repetto formation of lower Pliocene, probable Modelo formation of upper Miocene, and the Las Llajas (?) formation of Eocene age. Details on surface and subsurface formations have been ably described in reports by Oakshott (2), (4) and Willis (3).

Producing Zones: The three producing zones have been designated from bottom to top, the Lower Kraft, Upper Kraft, and Upper Upper Kraft.

a) Lower Kraft, in the lower Pliocene-Repetto formation, ranges from 300'to 450' in thickness at a maximum depth of 2300'. It is productive of 20 to 25 gravity oil northeast of the northwest trending Orwig fault in the Juanita area, and 12 to 16 gravity oil in the Kraft-York area. Some initial productions were as high as 3000 BOPD.

b) Upper Kraft, in the middle to upper Pliocene Pico formation, ranges in thickness from 170' to 250' and is productive of 11 to 17 gravity oil in the Kraft-York area only. Initial productions ranged from 25 to 175 BOPD.

c) Upper Upper Kraft consist of approximately 100' of pay in the Upper Kraft shale series of Willis (3) within the Sunshine Ranch Member of upper Pliocene Pico. Initial rates range from 10 to 15 BOPD. This zone is now productive in the E/2 of SW/4 of Section 31, T.4N, R.15W and in the NW/4 of Section 6, T.3N, R.15W.

Structure: The Placerita oil field is a faulted monocline; its accumulation is controlled to the north by the San Gabriel fault, to the east by the north-south trending normal Whitney fault and to the south by faulting, tar-sealing and lensing. Up-dip lensing within the Pico formation and unconformities at the base of the Saugus and Pico formations have also probably played a part in the accumulation of oil. Within the field, faults, such as the Orwig fault, with small displacements and no surface expression have separated the field into pools with different gravities.

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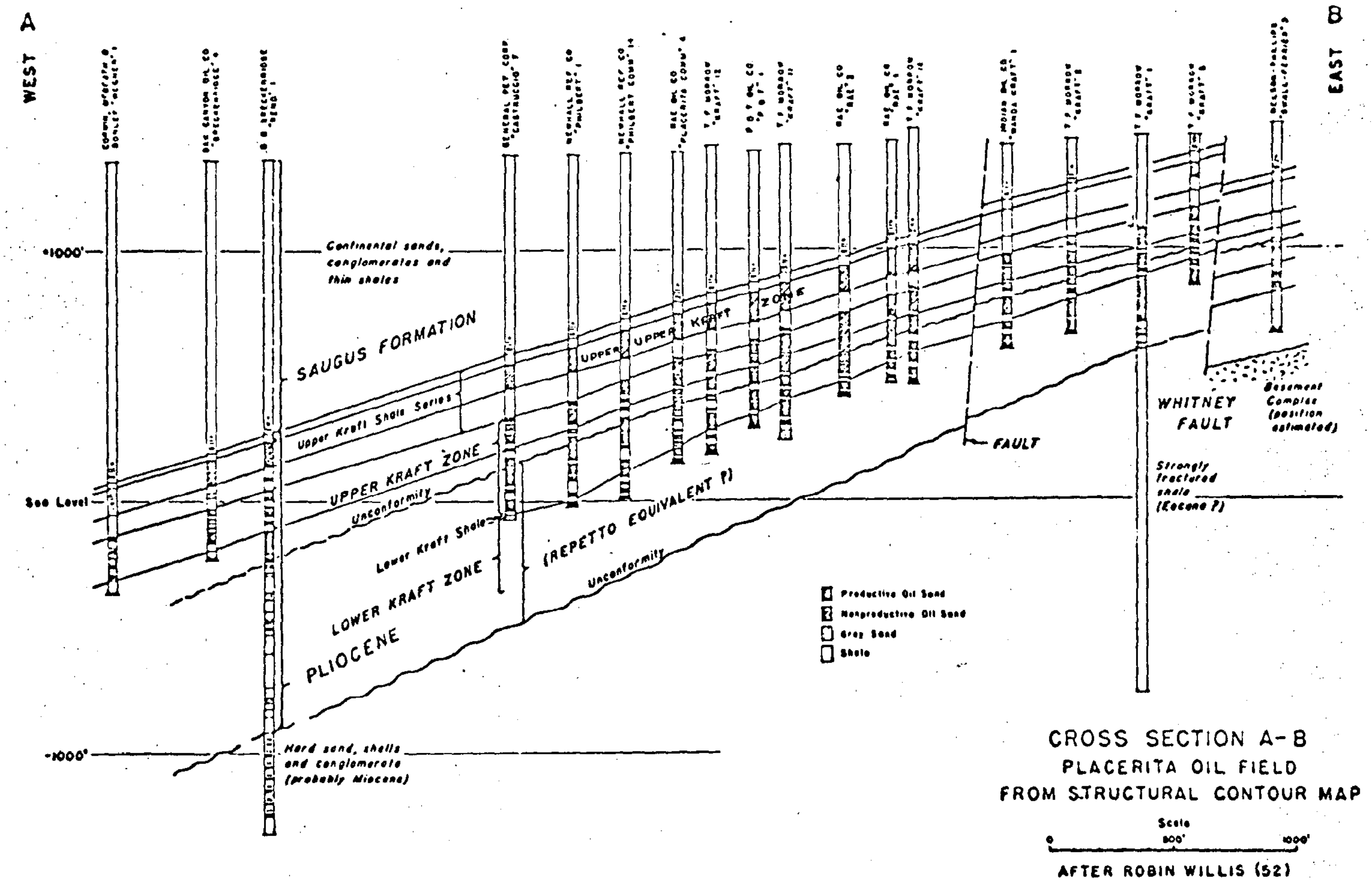
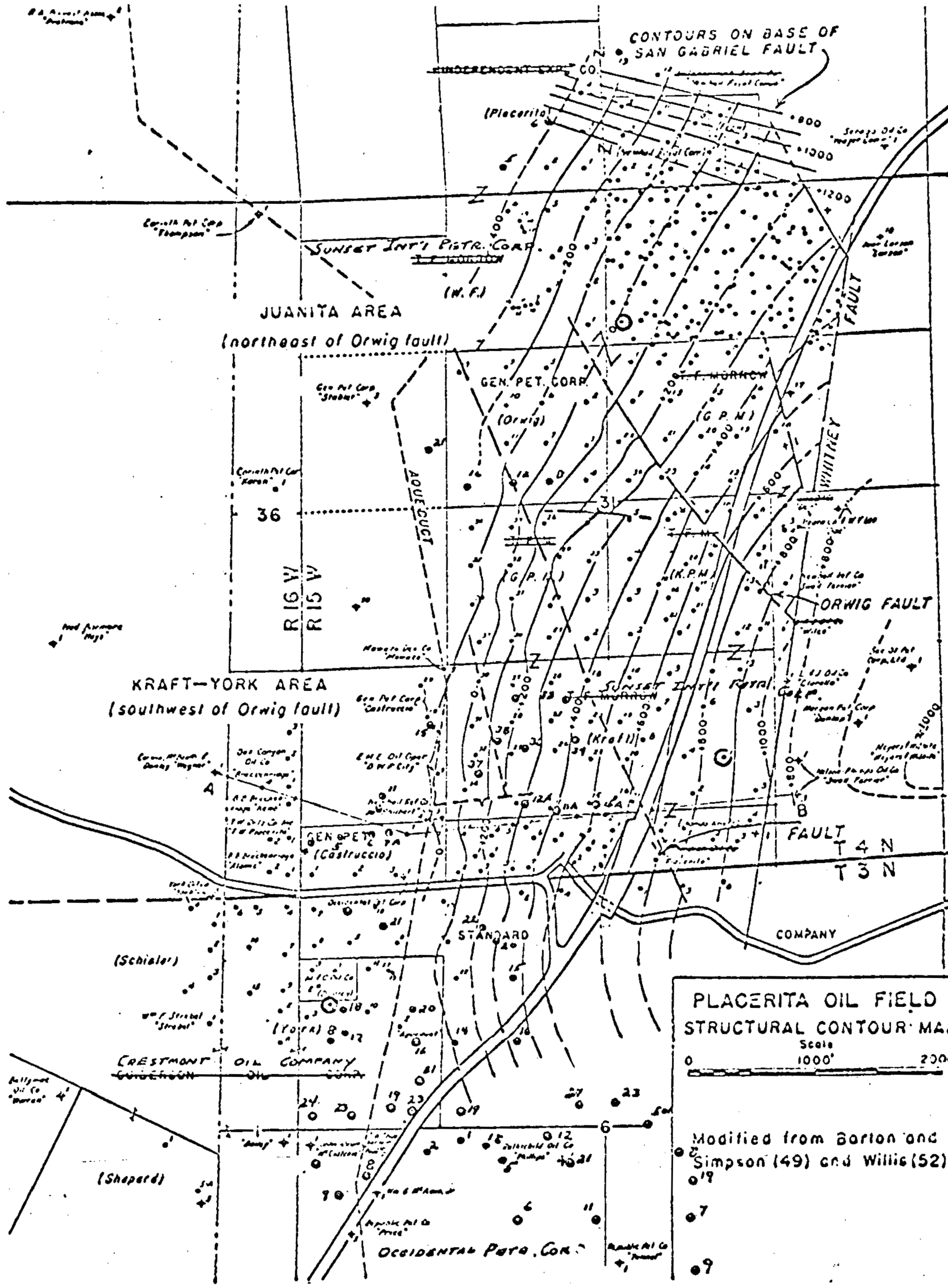
5. Tudor, R. T., 162 Recent Developments in the Kraft-York Area of the Placerita Oil Field, Summary of Operations, California Oil Fields: California Division of Oil and Gas , Vol. 48, No. 1, pp. 47-53.

SUMMARY OF ROCK FORMATIONS

Age	Formation or member	Description	Maximum thickness	Economic interest
Recent	Alluvium	Stream sands and gravels of Placerita Canyon and Santa Clara River	100	Water supply. Gold in Placerita Canyon.
	Unconformity			
Upper Pleistocene	Younger terrace deposits	Elevated, but unfolded, older alluvium.	175	Gold in Placerita Canyon.
Upper Pleistocene	Older terrace deposits	Similar to younger terrace deposits, but affected by folding and faulting.	500	None recognized.
	Major Unconformity			
Lower Pleistocene	Saugus formation	Continental sandstone and conglomerate	2000	Barren in the oil field.
	Unconformity, but no angular discordance in oil field			
Upper Pliocene	Pico formation: Sunshine Ranch Member	Continental and brackish-water conglomerate, greenish sandstone and mudstone, thin beds of fresh-water limestone, redbeds.	1300	Some oil-saturated sands (probably includes "Upper Kraft shale series" of Willis (52)).
Upper Pliocene	Pico formation: Upper Pico Member	Coarse to fine marine sandstone and conglomerate; fossiliferous uppermost Pliocene (probably Santa Barbara zone).	1000	Oil sands (includes upper part of "Upper Kraft zone" of Willis (52)).
Middle Pliocene	Pico formation: Lower Pico member	Marine sandstone and conglomerate; massive fine sandstone and siltstone; fossiliferous calcareous sandstone beds (San Diego fauna).	700	Oil sand and seeps (probably includes lower part of "Upper Kraft zone" of Willis (52)).
	Unconformity			
Lower Pliocene	Repetto fm.: Repetto siltstone member	Marine brown and gray siltstone and fine sandstone; conglomerate.	300	Some oil sand and seeps in exposures.
Lower Pliocene	Repetto fm.: Elsmere member	Marine fossiliferous coarse sandstone and conglomerate, continental at north end	300	Oil sand and seeps S. of area mapped. (Probably essentially equivalent to "Lower Kraft zone" of Willis (52)).
	Unconformable on basement			
Upper Miocene	Modelo formation	Not exposed in oilfield; in subsurface of western part of field. Marine brown sandstone, shale; interfingering continental beds.	1500	Not productive in Placerita field; has produced in Tunnel area (Willis 52).
	Unconformity in outcrop north of mapped area.			
Upper Miocene	Mint Canyon formation	N. of San Gabriel fault only. Continental sandstone and conglomerate; tuff beds; lake beds.	2400	None recognized.
	Not in contact			
Eocene and Paleocene	Domengine and Martinez formations	Well-indurated shale, sandstone, conglomerate. Domengine, Capay, and Meganos recognized in the subsurface.	2000	Reservoir for light oil in nearby fields; non-productive in Placerita field.
	Major unconformity			
Pre-Tertiary	Granitic rocks; Rubio diorite gneiss; Placerita series.	Irregular remnants of Placerita metasedimentary rocks (Paleozoic?); Rubio diorite gneiss (late Paleozoic?); both intruded by granitic rocks (U. Jur.-Cret.?)		Reservoir rock for a little light oil in Placerita schist area.



CALIF. DIV. MINES BULL. 170



⊙ DISCOVERY WELL

CALIF. DIV. MINES BULL. 170

VASQUEZ FORMATION

By Gordon B. Oakeshott

State Division of Mines and Geology, San Francisco

In Upper Agua Dulce Canyon, in Upper Bouquet Canyon, and visible from parts of Soledad Canyon are spectacular, rather steeply-dipping, outcrops of brightly-colored sandstone and conglomerates. These are the coarser sedimentary beds of the Vasquez Formation. Particularly striking outcrops are the coarse-grained, yellow gray sandstones and conglomerates which form denuded outcropping beds 30 or 40 feet high, dipping approximately 40° to the southwest in the Vasquez Rock Park area. Bouquet Canyon highway passes across a series of massive reddish outcrops, 100 feet or more in height, of near vertical east-striking reddish-brown Vasquez conglomerate.

Lithology and distribution

For the most part the Vasquez Formation consists of light-colored and highly-colored red, yellow, and buff sandstone, conglomerate, fanglomerate, and smaller proportions of mudstone and shale, interbedded with thick basaltic lava flows. Total thickness of the Vasquez Formation is about 8800 feet, of which as much as half is volcanic.

The formation is distributed over several square miles of the northeastern part of the Soledad Basin which represents the extreme eastern end of the Ventura Basin between the western end of the San Gabriel Mountains on the south and the Sierra Pelona on the north. The Vasquez rocks occupy a faulted structural basin which plunges 25° to 40° toward the southwest from the northeastern corner of San Fernando quadrangle.

The most complete and continuous section of the Vasquez Formation is exposed in Escondido Canyon, east of Agua Dulce Canyon. There it consists of about 500 feet of very coarse basal conglomerate and sandstone, 3800 feet of basaltic volcanic rocks, and 4500 feet of sandstone, shale, and conglomerate.

The Vasquez sediments were deposited in a narrow basin flanked by steep mountainous topography on three sides, and flaring to the west.

The general course of deposition of the coarse land-laid sediments was toward the west and in that direction the sediments tend to become less coarse and thin quite rapidly. As the beds thin, more lake deposits appear, including borate-and gypsum-bearing shale and sandstone, which are exposed in upper Tick Canyon. Toward the west the volcanics finger out into a series of thinner individual flows with more numerous interbeds of sediment.

The Vasquez Formation is characterized by extreme variation in grain size, from fine-grained, thin-bedded shales and mudstones to monolithologic breccias containing clasts several feet in diameter. Very coarse clastic sediments with marked angularity of grain and indistinct bedding, locally derived from the underlying crystalline rocks, make up a large part of the formation. In some places, however, well-bedded, indurated, coarse-grained sandstone and thin-bedded lake-deposited, highly-colored shales and siltstone are prominent.

Parts of pebbles in the formation clearly indicate local derivation from the anorthosite complex which flanks the eastern Soledad Basin on the south and from Cretaceous granitic rocks which intrude the Sierra Pelona greenschists of unknown age on the north.

Stratigraphic relationships

The Vasquez Formation is in most places in fault contact with granitic rocks, but in a number of places in the northeastern corner of San Fernando quadrangle basal Vasquez conglomerate lies directly on eroded Precambrian syenite and related hornblende diorite rocks. This contact is best exposed just north of Escondido Canyon Road and about 1 mile east of Elkhorn Lodge. The Vasquez is unconformably overlain by the Tick Canyon Formation and by the Mint Canyon Formation. The strong angular unconformity between Tick Canyon and Vasquez Formations is best exposed on the west side of Tick Canyon, where Tick Canyon basal conglomerate overlaps, from east to west, the upper volcanic member of the Vasquez and an upper sandstone-shale member of the Vasquez, to lie on the lower volcanic member. Dips in the Vasquez beds are about 55° south; the overlying Tick Canyon beds dip 15° to 20° south. Basal Tick Canyon beds commonly contain a noticeable amount of volcanic debris derived from the underlying Vasquez Formation.

The Mint Canyon Formation overlaps the Tick Canyon, both east and west, to lie directly on the Vasquez formation. In the first small canyon west of Agua Dulce Canyon, Mint Canyon fanglomerate beds striking northeast and dipping 22° northwest, lie on well-stratified Vasquez beds which strike nearly due north and dip 35° west. The Mint Canyon fanglomerate here includes pebbles of Vasquez volcanics and sandstone.

Age and correlation

No fossils have been found in the Vasquez Formation but the overlying Tick Canyon Formation contains a rather abundant vertebrate fauna of late early Miocene age. Although only the crystalline rocks are found below the Vasquez Formation in the upper Agua Dulce Canyon area, the formation unconformably overlies fossiliferous Paleocene beds in the Tejon quadrangle a few miles to the west. In the eastern Ventura basin, the highest Eocene marine sediments are of middle Eocene (Domengine) age, as in the vicinity of the Placerita oil field. In the Sespe Creek area further west, the middle Eocene Llajas Formation is overlain unconformably by the nonmarine Sespe Formation, which has yielded some vertebrate fossils. Therefore, the probable lower age limit of the Vasquez Formation is late Eocene. It appears most likely that the Vasquez is essentially equivalent to the Sespe Formation of the type locality and that its age limits range over the time period of late Eocene to earliest Miocene.

Tick Canyon borate mine

From time to time the thin, silicified siltstones and tuffaceous sediments of the Vasquez have been quarried for colored roofing granules. Mineral collectors have also found opal and chalcedony in the amygdules in the vesicular basalts of the Vasquez Formation.

By far the most important mineral commodity was, of course, the borates mined from 1908 to 1922 in upper Tick Canyon from the finer-grained lake sediments of the Vasquez Formation.

The most important mineral was colemanite (a hydrous calcium borate). About 100,000 tons of colemanite, valued at over $3,000,000, were produced, mainly by the Sterling Borax Company. This was used principally for the manufacture of commercial borax. The colemanite occurs in thinly-bedded, fine-grained red-and-brown sandstone and mudstone, and purple, silty shale close to the top of the Vasquez Formation and between vesicular flows of basalt. The principal colemanite-bearing beds at the mine strike N. 75 W. and dip 70° south. Other boron minerals which have been found in this area include howlite (a hydrous calcium boro-silicate), probertite (a hydrous sodium calcium borate), ulexite (a hydrous sodium calcium borate), and veatchite (a hydrous strontium borate).

It is likely that this area was a borax-ulexite playa lake quite similar to parts of the present floor of Death Valley, and that after uplift and tilting of the Vasquez beds, sodium was removed in solution and the boron combined with calcium from calcareous sediments to form colemanite. The ultimate source of the boron was probably the volcanic activity which was closely associated with the playa beds.

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HISTORY OF PETROLEUM

PICO CANYON - NEWHALL AREA

LOS ANGELES COUNTY, COUNTY, CALIFORNIA

BY ROBERT J. HINDLE

The California Star Oil Company representing San Francisco investors including such persons as A. J. Bryant, Mark McDonald, Capt. James McDonald, J. A. Scott, D. G. Scofield and F. B. Taylor began the exploration for petroleum in the Pico Canyon Area in the 1870's.

Mr. D. G. Scofield, representing the California Star Oil Works Company, obtained by assignment of leases from C. C. Mentry interests in the Newhall Area. C. C. Mentry as drilling superintendent of the newly formed company outfitted a steam rig. This high speed, heavy equipment was rigged up on the Pico #4 test well. This exploratory well was drilled to a depth of 600' where it encountered the pay section and flowed oil at a rate of 150 barrels a day. At the time of its discovery, 1876, this was the most prolific well drilled in California.

As a result of the production established in the Pico Canyon Area, Mr. J. A. Scott obtained a site adjacent to the Southern Pacific Railroad tracks in the Newhall Area just south of the present Newhall townsite. A five mile pipeline 2" in diameter was laid from the Pico Canyon Field to the Newhall Refinery in the year 1879 to process the increased production from the Pico Canyon Development.

The Scott-Barker Newhall Refinery was composed of a series of pot stills which were used chiefly to produce kerosene and heavy lubricants. This pioneer oil refinery was the first commercial refinery operation in California and due to the generosity of Standard Oil Company of California the site and installations have been set aside as a monument to the foresight of the early California oilmen.

A portion of the refinery has been removed to be added to a museum. The Standard Oil Company of California has recently appropriated funds for the restoration of this momento of the oil companies' past. The location is marked by state historical marker signs and is located south of the town of Newhall adjacent to the Southern Pacific Railroad tracks. If you have not had the opportunity of visiting this site, the side trip is recommended.

GEOLOGY OF THE PICO CANYON ROAD

PICO CANYON, CALIFORNIA

BY ROBERT J. HINDLE

Mileage

Beginning at the intersection of U. S. Highway 99 and Pico Canyon road, one proceeds west through a series of road cuts which expose the Pleistocene-Pliocene Saugus formation. 0.0

This sedimentary series of predominately non-marine sediments has been described as follows:

"The Saugus formation consists of lenticular units of light-colored loosely consolidated poorly bedded ill-sorted conglomerate, conglomeratic sandstone and sandstone alternating with intervals of greenish-gray siltstone and silty sandstone and light brown to moderate reddish-brown sandy siltstone and claystone. The proportion of greenish beds is greater in the lower part and the proportion of reddish beds is greater in the upper part of the formation."

Geology of Southeastern Ventura Basin, Los Angeles County, California, E. L. Winter, June 1954, Page 82.

At 1.2 miles from U. S. Highway 99, the gradational contact of the Saugus-Pico may be observed. This Pliocene Pico series of Marine rocks consist of series of sandstone, graded conglomerate and siltstone. This section of the Pico is reflected in the bold topography in the bluffs, ridges and highs in the area. 1.2

Beneath these units lie the Pico siltstone, consisting chiefly of soft, generally poorly bedded light olive-grey siltstone, containing dark yellow-brown iron stained concretions and interbeds of silty sandstone, ranging in color from olive-grey to dark yellow-brown based on degree of weather. This lithologic unit is subject to extreme weathering resulting in valleys, rolling hills, and generally poor exposures. 2.0

The material within the Pico Canyon from the conglomerate outcrops of the Upper Pico to the entrance of the Pico Canyon Proper consists of the outcrops of the Pico siltstone. The Pico formation contains both micro and mega fossils which are, however, generally poorly preserved.

Just beyond the ranch buildings, located on the original Pico townsite, the road crosses the contact between the Pico and the underlying Towsley formation of Upper Miocene-Lower Pliocene age. This formation was set out by Doctor E. L. Winter and consists of a series of sandstones and conglomerates within brown mudstones, siltstones and shale interbeds. The conglomerates are calcite cemented and form the pronounced ridges and outcrops along the Pico Canyon road, between the contact and the picnic area. These conglomerates contain material from pebbles to boulders, consisting of volcanic rock, andesite, quartzite and anorthosite. This formation is of Marine origin and contains rare identifiable fossils; however, fragments of mollusks and mud pectens are common. 2.8

The Towsley formation lies upon the Upper Miocene Modelo shale. The outcrops of this Upper Miocene unit are not evident along the Pico Canyon road; however, the Miocene Modelo section can be found in the core of the Pico Canyon anticline, south of the Pico Canyon picnic area. This unit consists of principally silicious shales, mudstones, and contains only minor lenses of sandstone with occasional beds of grey, impure limestone.

ROAD LOG

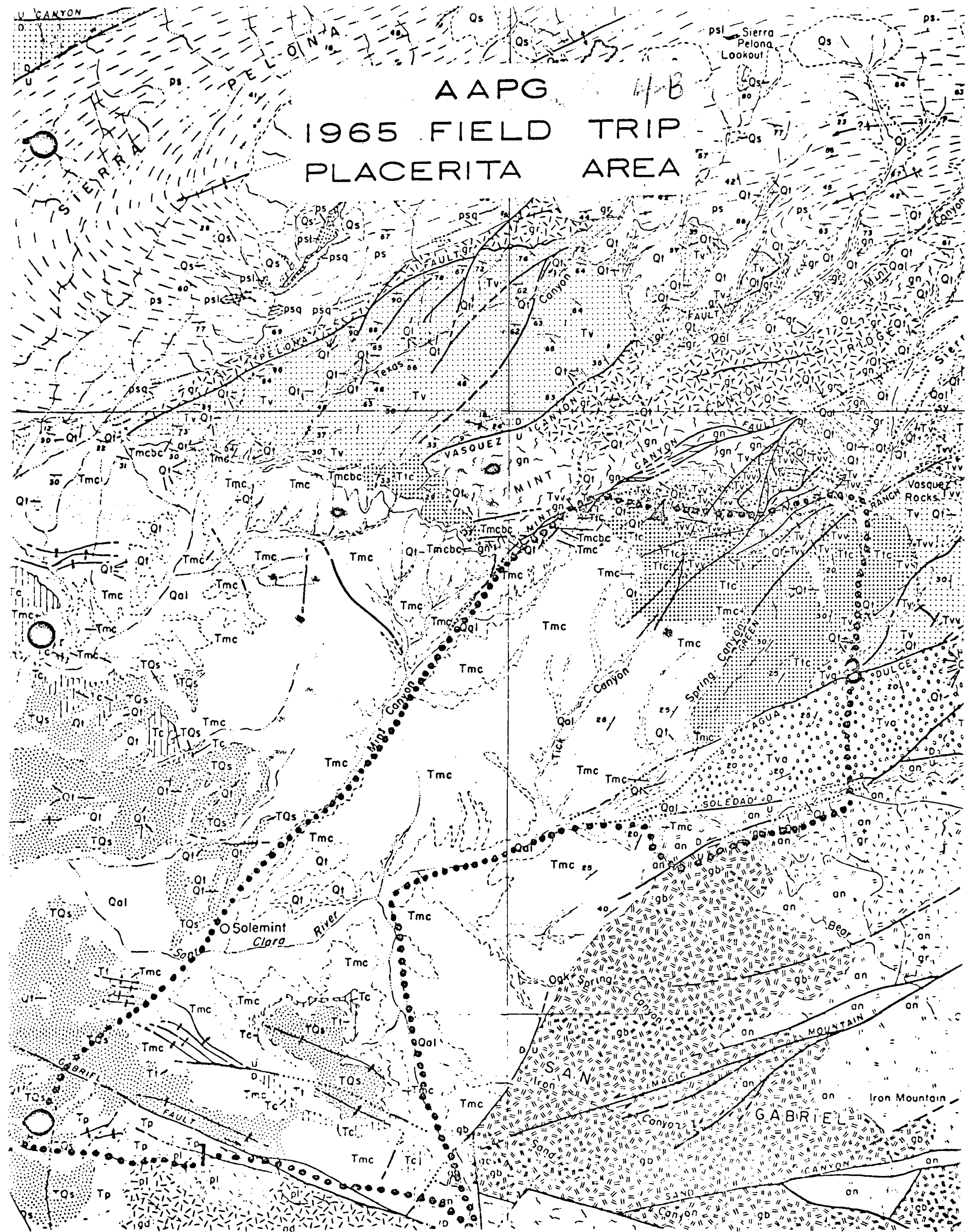
0.0. Placerita Canyon Park Stop #1.
0.1 Placerita Canyon Road - Park entrance. Turn Right to the East.
0.2 Pico - outcrops in road cut.
0.3 Terrace - Saugus Formation.
0.5 Fault zone Upper Pico - road cuts.
0.7 Road cut Upper Pico - small fault.
0.9 Road cuts Upper Pico - South across canyon Schist and Basement Complex.
1.0 Red beds - siltstones and sand - Upper Pico.
1.1 As above.
1.3 Springs, broken, contorted zone, sliver fault adjacent to San Gabriel Fault.
1.4 San Gabriel Fault Trace at end of cut; sag pool and contact at Green Oak at end of cut. Fault dips 61°N. Faulting Pico/Saugus.
1.5 Terrace - Saugus. Cross-bedding, cut and fill. Deposition.
1.7 Note road on hill to South - goes to old oil wells drilled in 1890 to a depth of 580-2310'. All wells are South of the Placerita Fault, which parallels the San Gabriel Fault.
1.8 Saugus Formation.
1.9 Note vegation change Mint Canyon. Castaic Formation form bluffs and cliffs to the North and Northeast.
2.7 Mudstone - Mint Canyon Formation.
2.9 Breccia Fault Zone.
3.0 North Mint Canyon with Modelo (?) on top of hill. South of road Castaic Formation outcrops across Valley Fault.
3.2 Mint Canyon.
3.5 Look back to the West note: the Mint Canyon, Castaic-Towsley or the Mint Canyon-Modelo-Pico series on the bluff.
3.7 Intersection Placerita Canyon Road and Sand Canyon Road. Turn South or to the right.
3.8 Angeles National Forest entrance. Check smokes!
4.0 Note to South: the Pine trees are in the Basement Complex South of the San Gabriel Fault.
4.1 Terrace.
4.2 Basement - Norite - Gabbro. - weathered recrystalized. Faulted.
4.5 Entrance to Lower Live Oak Camp Ground. Turn to right; into grounds. <u>Stop #2</u>
0.0 Stop #2
0.0 North on Sand Canyon Road.
0.5 Small fault in the Basement Complex.
0.8 Intersection with Placerita Canyon Road. Proceed North on Sand Canyon Road. Note: red to brown fanglomerates to the East.
0.9 Mint Canyon outcrops in road cuts at Ruthspring Road junction.

1.1	Look East to Iron Canyon Area - Note: Mint Canyon in fault contact with Basement.
1.3	Note: Light grey hills to North and East are Mint Canyon outcrops.
2.2	Terrace on Mint Canyon.
2.4	Mint Canyon.
2.9	Terrace.
3.4	Mint Canyon in road cut.
3.5	Terrace.
3.6	RR track-proceed.
3.8	Bridge Soledad Canyon - Santa Clara River.
4.0	Junction with State Highway #14-proceed under highway.
4.1	Soledad Canyon Road. Turn right or East.
4.1	Mint Canyon in road cut.
5.2	Mint Canyon.
5.3	Ahead to the SE. Light outcrop on hills Anorthosite.
6.4	Tick Canyon Junction.
6.5	Proceed under State Highway #14.
6.6	Gravel plant. North channeling in Mint Canyon along cut for Highway #14.
6.9	Mint Canyon outcrop.
7.1	Mint Canyon cut and fill, X bedding.
7.2	Look South, across valley white outcrop-Anorthosite in fault contact.
7.7	Bridge across Agua Dulce Creek. Historic Lang Railroad station to the South.
7.8	Red Mint Canyon near basement contact. Note: basement rubble.
8.1	Fault-Soledad fault system Mint Canyon/Basement Complex.
8.2	Basement Complex Anorthosite, dark metamorphosed. Dikes and intrusions. Fault evident in outcrop to West across canyon.
8.4	Fault Basement Complex and Terrace? (Sediments?)
8.5	" " " " ?
8.6	Anorthosite with metamorphosed dikes.
8.8	Tunnel - Anorthosite with " "
9.3	Soledad Fault. Mint Canyon/Basement Complex.
9.4	Recent alluvium and terrace.
9.7	Anorthosite/Mint Canyon - Soledad Canyon Fault Contact.
9.9	Agua Dulce Canyon. Turn off to the left or NE at the Agua Dulce Canyon Road and Soledad Canyon Road Junction. Note: The Soledad-Pole Canyon Fault continues East up canyon.
10.2	Mint Canyon. Conglomerate principally Anorthosite boulders.
10.4	" " " " "
10.7	<u>Stop #3</u>. Mint Canyon conglomerate cross the Agua Dulce Fault.
0.0	Stop #3.
0.7	Bridge. Mint Canyon-Vasquez in fault contact West. Vasquez tan sandstones, Mint Canyon on East at Agua Dulce Fault.
0.9	Vasquez sands, red-green clays and mudstone.

1.3	Vasquez Formation.
1.3	Bridge - Escondido Creek.
1.4	Mint Canyon - Vasquez contact.
1.5	State Highway #14. Proceed North under highway, Mint Canyon in cut.
1.7	Volcanic flows - breccia of the Mint Canyon (Upper Vasquez).
1.9	Tuffs.
2.1	Volcanic flows, breccia, tuffs.
2.5	Note: Elkhorn Fault - Green Ranch Fault to SW in the bluff.
2.6	Alluvium.
2.8	Look East to the famous Vasquez Rocks.
3.0	Intersection Davenport Road-Agua Dulce Road. Proceed West, turn left on Davenport Road. Look North ridge on horizon Peloma Schist.
3.4	Basalt - badly weathered with light tuffaceous interbeds.
3.5	Vasquez with volcanic flows.
3.6	Vasquez sandstone.
3.7	Davenport Road and Trail Road. Vasquez outcrop sandstone and conglomerate.
4.0	Vasquez red beds with interbedded tuffs and volcanic flows.
4.4	Vasquez lake beds.
4.5	Vasquez - borates, volcanics, lake beds Tick Canyon Area. Stop #4.
0.2	Lake beds. - Vasquez Formation.
0.4	Volcanics.
0.5	Mine dump Tick Canyon Area. - Volcanic outcrops.
0.6	Sterling Mine to the North up Tick Canyon.
0.7	Lake beds Tick Canyon, Formation.
0.8	Mudstones - lake beds - Tick Canyon, Formation.
1.0	" " " "
1.1	Tick Canyon - Volcanics - Vasquez - to the North - Mint Canyon Fault contact between Basement and the Vasquez.
1.2	Tick Canyon? Lake beds.
1.5	" " North across valley the sedimentary series as at 1.1 point. The tan to brown hills, to the north, are basement outcrop which in this area is granitic.
1.6	Mint Canyon Formation in Mint Canyon.
2.0	The Davenport Road - Sierra Highway junction. - Turn South or left.
2.0	Look West-Note: the Basement and Mint Canyon in fault contact along the Mint Canyon Fault.
2.5	Mint Canyon Formation.
2.9	" "
3.1	" " sandstones to the East.
3.4	" "
3.6	Halfway House.
4.0	On East - Mint Canyon outcrop.
4.4	Mint Canyon Formation.
4.7	Mint Canyon junction of Vasquez Canyon Road - and Sierra Highway.
5.3	Forest Park townsite.
6.4	Mint Canyon with gravels and fanglomerate.
6.9	Bridge. Mint Canyon Creek.
7.3	Mint Canyon townsite.
7.8	" " "
8.1	Signal. Junction State Highway #14, and Sierra Highway or Soledad Canyon Road and Sierra Highway.
8.3	Bridge.

8.6	Towsley Formation in bluff on the left.
8.3	Mint Canyon Formation including lake beds, channeling and gastropods.
9.0	Tips.
9.7	Sunshine Ranch Formation - Ilmenite sand interbeds.
10.3	" " " " " "
10.5	San Gabriel Fault.
10.5	Placerita Oil Field Saugus - Fanglomerates, conglomerates overlying Pico.
11.2	Sand, Fanglomerates.
11.5	Oak of the Golden Dream Historical Marker.
11.6	Bridge over Placerita Canyon Road.
11.7	Turn right, or West off highway on offramp.
11.8	Proceed to the East under highway to Placerita State Park 1.9 miles.
11.9	Stop sign. - Turn left or East.
12.6	Saugus - Sands and conglomerates.
12.7	Golden Oak Ranch; Gold discovered 1842.
12.8	Pico, siltstone, mudstones, and sandstones.
13.5	Basement Complex Granodiorite and meta-sediments (Placerita). Pico in normal contact (?) with basement series.
13.7	Placerita State Park entrance. Placerita fault separates the Pliocene sediments to the North and East from the basement series.
13.8	Lunch.
32.8	Total mileage -

All mileage is measured from each stop in tenths of miles by a standard car odometer.


AAPG
1965 FIELD TRIP
PLACERITA AREA
4-B
SIERRA PELONA
Sierra Pelona Lookout
PELONA FAULT
Texas Canyon
VASQUEZ CANYON
MINT CANYON FAULT
MINT CANYON
SIERRA PELONA RIDGE
SOLEDAD CANYON
Vasquez Rocks
AGUA DULCE
Green Spring Canyon
Tick Canyon
Mint Canyon
Solemint
Santa Clara River
Oak Spring Canyon
Bear Canyon
SAN GABRIEL
SAN GABRIEL FAULT
MOUNTAIN
Iron Mountain
Magic Canyon
Sand Canyon
SAND CANYON